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ABSTRACT

The need for broad cooperative effort directed toward the enhancement of science and mathematics education, including environmental science and technology, has been recognized as a national priority in the United States by government, industry, and the academic community. In an effort to address this need, the Partnership for Environmental Technology Education (PETE) has been established in the five western states of Arizona, California, Hawaii, Nevada, and Utah. PETE's overall objectives are to link the technical resources of the U.S. Department of Energy, the U.S. Environmental Protection Agency, the U.S. Department of Defense and NASA laboratories and facilities, and private industry with participating community colleges to assist in the development and presentation of curricula for training environmental hazardous materials technicians and to encourage more transfer students to pursue studies in environmental science and engineering at four-year institutions. Preliminary results of a national assessment of the demand for these two-year-level technicians indicate the demand. Standing working groups have been formed to develop teaching materials and standards and an appropriate certification process. The PETE methodology is now being extended nationally through highly leveraged cooperation between participating federal agencies, private industry, and the academic community. (YLB)

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## Partnership for environmental technology education

by Paul R. Dickinson

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## Abstract

*The need for broad cooperative effort directed toward the enhancement of science and mathematics education, including environmental science and technology, has been recognized as a national priority in the USA by government, industry, and the academic community alike. In an effort to address this need, the Partnership for Environmental Technology Education (PETE) has been established in the five western states of Arizona, California, Hawaii, Nevada and Utah. PETEs overall objectives are to link the technical resources of the US Department of Energy, the US Environmental Protection Agency, the US Department of Defense and NASA laboratories and facilities, and private industry with participating community colleges to assist in the development and presentation of curricula for training Environmental-Hazardous Materials Technicians and to encourage more transfer students to pursue studies in environmental science and engineering at four-year institutions. The PETE methodology is now being extended nationally through highly leveraged cooperation between participating federal agencies, private industry and the academic community.*

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## Introduction

The need for broad cooperative effort directed toward the enhancement of science and mathematics education in the United States has been recognized as a national priority by government, industry and the academic community alike. Within the context of this broad need, the US Department of Energy (DOE), the US Environmental Protection Agency (EPA) and the US Department of Defense (DoD) have defined needs driven or specific interests which require increasing the numbers of qualified graduates in areas of environmental science and engineering, including technicians, and fostering improved public literacy in environmental science and waste management. Carefully targeted education intervention programmes are required if these important goals are to be realized.

There are approximately 1200 community, technical and junior colleges in the US with a 1989 student population of 5.7M. This does not include another 5.0M non-credit enrolled students attending these two-year institutions. On the basis of sheer numbers alone, these institutions represent a significant, nationwide resource that should play a key role in the conduct of a successful Environmental Protection/Restoration and Waste Management education programme.

Community colleges have been in the process of a major transition during the 1980s. They have moved towards a much stronger role in vocational education and in supporting US industry. Despite this major shift toward vocational education, however, the nation's community colleges still represent a key transition point for millions of students (particularly minority students) between high school and the four-year institutions. Operating on a philosophy of higher education opportunity for all, with minimal entrance requirements and low cost, the community colleges afford the average high school student the opportunity to start college when they may not have qualified to enter a four-year institution, or may still be trying to decide the appropriate direction of their college careers. The community colleges also increasingly represent the easy access, low cost alternative for people already in the work force to return for continuing vocational training or retraining for new career directions.

For these reasons, most of the minority or other disadvantaged students presently pursuing post-secondary education in the US today are attending a community college. An environmental education intervention programme which recognizes current problems in the nation's education system and is geared to the realities of changing demographics must focus adequate programmatic attention on this pivotal segment of the education pipeline.

# I. Organisation and programmes

The Partnership for Environmental Technology Education (PETE), a regional programme which could be extended nationally, has been developed and implemented to link the technical resources of federal laboratories and other facilities and the private sector with regional community colleges to provide direct technical assistance for:

- development and presentation of Environmental-Hazardous Materials Technician curricula at the two-year degree/certificate level;
- development/enhancement of environmental science and pre-engineering curriculum targeting the attraction and preparation of transfer students to four-year institutions.

This is a five-year programme which will evolve through a partnership of government, industry and academia, and include the participation of the DOE National Laboratories, the Nevada Test Site, DoD bases and facilities, and regional EPA and NASA laboratories. PETE is being supported by its sponsors during the first eighteen months on a pilot basis in five western states.

## A. Goals

The goals of this regional partnership can be summarized as follows:

1. Provide a mechanism for bringing the technical expertise of the DOE, EPA, DoD and NASA laboratories and facilities into direct and continuing support of the community colleges.

2. Accelerate the development and implementation, and enhance the technical foundation of Environmental-Hazardous Materials Technician curricula to meet the near-term and long-term human resource needs of both government and industry.

3. Provide a mechanism for coordinating greater private industry, government, academic, professional society and laboratory collaboration at the community college level.

4. Provide a mechanism for assisting with outreach initiatives to feeder high schools and articulation to four-year curricula in environmental science and engineering at participating universities.

5. Develop a continuing collaborative and mutually supportive relationship between DOE, EPA, DoD, and NASA laboratories and facilities in support of national education objectives.

## B. Pilot programme

The first year effort has been devoted to developing and implementing the programme on a pilot basis in the states of Arizona, California, Hawaii, Nevada, Utah. This has included two primary initiatives:

1. Environmental-Hazardous Materials Technician curriculum development and implementation: A programme is in place to assist community colleges in implementing this curriculum in the five-state region, including accelerated instructor training and creative approaches to assuring the availability of state-of-the-art equipment and teaching aids.

2. Resource Instructor Institute in the Environmental Sciences: Each community college within the five-state region will be invited to nominate a science, math or hazardous materials technician instructor to participate in a regional instructor network. The Institute will serve as a formal mechanism for the community colleges, DOE, EPA, DoD and NASA

laboratories and facilities, the private sector and professional societies to coordinate on:

- regular information exchange (semi-annual, 2-day conferences),
- direct laboratory and industry support to curriculum presentation,
- curriculum articulation with four-year institutions,
- development and implementation of high school or community outreach programmes (e.g. 2+2+2 or Tech Prep),
- laboratory and industry summer work/research, and continuing education opportunities for instructors and students,
- DOE/EPA/DoD/NASA technology transfer,
- recruiting opportunities for DOE, EPA, DoD, NASA, their contractors, and private industry.

This pilot programme has been developed and implemented through the collaboration of several key regional players:

- Arizona, California, Hawaii, Nevada, Utah Community Colleges
- Department of Defense (DoD) facilities (yet to be defined)
- Environmental Monitoring Systems Laboratory (EPA)
- Industry Education Council of California
- Jet Propulsion Laboratory (NASA)
- Lawrence Berkeley Laboratory (DOE)
- Lawrence Livermore National Laboratory (DOE)
- National Center for Research in Vocational Education
- National Environmental Training Association
- Navajo Community College
- Nevada Test Site (DOE)
- Sandia National Laboratories, Livermore (DOE)

Also participating in the programme is the American Association of Community and Junior Colleges, the Department of Energy San Francisco and Nevada Field Offices, and the EPA Region IX Office. Representatives of the Environmental Protection Office in each of the five states will also be invited to advise the programme on a regular basis.

## C. Management

PETE is presently funded and overseen by the DOE and the EPA. Funding has been provided from the Washington, DC, Headquarters offices for both agencies. The San Francisco Field Office has the lead responsibility for DOE but coordinates the programme closely with the DOE Nevada Field Office. Field management responsibility for EPA is centered in the federal Region IX office in San Francisco. Funding for the programme is directed to the NETA in Phoenix, Arizona, which serves as Fiscal Agent.

Programme planning and direction for PETE is carried out by a Steering Committee operating under a set of approved bylaws. The Chair and Vice-Chair of the committee are community college representatives, with the Chairmanship rotated annually. The Steering Committee includes two representatives (one instructional, one administrative) from the community college systems of each of the five participating states as well as a representative of the environmental protection office of each state. The Committee also includes representatives of each participating federal facility, private industry, NETA, the National Center for Research in Vocational Education and the American Association of Community and Junior Colleges.

Once PETE is expanded to a national programme, it is visualized that a national programme coordinator will be established, probably in Washington, DC, to coordinate the activities of the regional partnerships. The goal will be to ensure some reasonable consistency of approach toward national objectives, but allow adequate autonomy to implement the

programme in a fashion that recognizes regional differences and takes full advantage of local resources.

## D. Budget

This five-year programme is being cosponsored by DOE and EPA as a collaborative initiative. Total funding for the Western pilot region was $250K in FY91. A budget of $950K is proposed for FY92 and it is now proposed that the Department of Defense join the Department of Energy and EPA in co-sponsorship of PETE. Additional funding support will be required for implementation in other regions. Significant support will also be sought from local industry in the five states. The State of California continues to commit funding for the development and implementation of the Environmental-Hazardous Materials Technician curriculum at additional colleges (seven in 1992), and the NCRVE has committed a total of $100K to the national labour demand study.

Funding to initiate this programme in the five-state region in FY91 was provided by the DOE Offices of Environmental Restoration and Waste Management and Contractor Human Resource Management.

## II. The role of employers, NGOs and the government

### A. Private industry

Private industry will play a vital role in the development and conduct of the programme. This will include participation in the Resource Instructor Institute and advising on curriculum development and presentation. Along with government, private industry will be a primary beneficiary of the significantly increased number of technician graduates which will result from this initiative. The Partnership is designed to provide a regular means for industry communication with community colleges on the changing needs of the private sector work force and to help ensure that the colleges Environmental-Hazardous Materials vocational programmes are addressing those needs. Federal agencies participating in PETE will draw primarily on private contractors to perform major environmental restoration and waste management projects. Substantial private sector funding and/or in-kind support will therefore be sought for the regional pilot programme. This will involve assistance in meeting equipment needs, co-sponsorship of semi-annual Resource Instructor Conferences, and summer internship opportunities for instructors and students.

The Industry Education Council of California (IECC), a statewide consortium of government, industry and academia, is a full partner in PETE, bringing direct access to many of the States major corporations. The organization's mission is to connect business, education, government and labour to ensure the development of a continuous, qualified labour supply for the economic viability of California. IECC has established a statewide coordinating committee to serve as the implementing agent for the PETE programme among Californian industry. This committee is chaired by a representative of the Unisys Corporation and includes IBM, Dow Chemical, Northrop Corporation, MacDonnell-Douglas, Southern California Gas Company, Southern California Edison and others. The California Manufacturers Association and the California Chamber of Commerce (to represent small business) will also be invited to join this IECC committee. Organizations similar to the Industry Education Council of California will be sought in Arizona, Hawaii, Nevada and Utah to coordinate private sector participation in the programme.

### B. Professional society participation

A number of professional societies also participate in meeting PETE's regional and national objectives. The National Environmental Training Association (NETA) is presently serving as fiscal agent for the Partnership. NETA is a nationwide organization of some 1300 professional environmental trainers which is providing valuable input on training needs and on resources and programmes in other parts of the country. The American Chemical Society (ACS) has also endorsed PETE. A number of activities of mutual interest are expected to be pursued, particularly if PETE is expanded nationally. ACS is prepared to assist with the development or improvement of the chemistry portion of the programme and to help publicize the Partnership through Society newsletters and conferences. We will also be exploring how PETE and the community college network can be linked to the ACS kindergarten-high school (K-12) science enhancement programme. Finally, the Air and Waste Management Association, an organization of some 14,000 professionals committed to improving environmental quality, is interested in a similar linkage to PETE to help support their public and K-12 environmental science literacy programmes, and to possibly serve as a

source of adjunct instructors for community colleges participating in PETE.

## C. National Institute for Environmental Health Sciences

The National Institute for Environmental Health Sciences (NIEHS), under the US Department of Health and Human Services, operates the Hazardous Materials and Waste Worker Health and Safety Training Program. This national programme, delivered through a series of regional consortia led primarily by universities and labour unions, is focused on providing required Occupational Health and Safety Administration (OSHA) and Emergency Response update training for workers employed in professions which expose them to hazardous materials. If PETE expands to a national programme, NIEHS may be interested in developing a relationship with the regional partnerships under which a public literacy programme in industrial health could be delivered through the community colleges. In the long term, there is also interest in accrediting OSHA and emergency response training programmes at participating community colleges in order to expand the outreach to the business community, particularly small and medium-size businesses.

# III. Skills and labour market needs

## A. Demand for environmental-hazardous materials technicians

Key issues which must be understood in structuring PETE and planning the extension of the Partnership methodology on a national scale are the current and projected demand and skills requirements for these two-year level technicians. The National Center for Research in Vocational Education (NCRVE), part of the University of California-Berkeley Graduate School of Education and a partner in PETE, is conducting a two-year national assessment of these issues. The objectives of this study, which is being co-sponsored by the DOE and US Department of Education are:

- to estimate the current projected labour market demand for technician-level employees with major responsibility for handling environmental hazardous materials;
- to identify alternative legislative and regulatory scenarios that may influence demand for these technicians;
- to identify the current and future educational skills required for the technician-level work force to meet public and private sector needs;
- to evaluate the skill levels of employees currently handling environmental hazardous materials;
- to identify and describe any gap between currently available skills and future national needs.

The methodology for this national assessment has been to conduct approximately three hundred intensive interviews with managers, supervisors and technicians working for public and private sector employers. This has included visits to most DOE laboratories and production facilities nationwide and EPA Superfund contractors. NCRVE staff and contractors have also gathered over 200 detailed skills analysis and labour market questionnaires from both public and private employers.

Some preliminary results of this intensive effort can be summarized as follows:

### 1. Labour market needs

- DOE personnel currently experience difficulty hiring qualified EHM technicians and related workers (nearly 65 percent have at least slight difficulty and 36 percent have difficulty or extreme difficulty).
- DOE personnel overwhelmingly see a need to hire additional EHM technicians in the next one to three years; hiring will be necessary to compensate for turnover, to increase staffing for current projects, and to staff new projects (82 percent see a need for more personnel).
- There is some evidence that overqualified individuals are working as technicians because of a lack of trained EHM techs (25 percent see an overqualification problem at least some of the time).
- Recruitment problems are often solved by raiding personnel from other DOE sites (two-thirds use other job sites as a source for EHM technicians, a higher percentage than for any other source).
- Most of these same circumstances also apply to private industry and local government operations.

### 2. Skills requirements

- Nearly 60 percent of DOE personnel see community college programmes offering the most desirable level of education for EHM technicians.
- However, only 30 percent consider a two-year degree most desirable.

- Short courses offered by community colleges or other providers are strongly favoured by many as the best education and training vehicle as opposed to a two-year Associate of Science degree.
- Among the 14 skills considered most important for EHM techs and related workers, half are basic skills that are unrelated to a specific technical field (e.g., problem solving, teamwork, verbal and written communications, high school maths); the other seven are very technical skill and knowledge areas such as maintaining protection, responding to chemical spills, hazardous waste labeling.

The NCRVE study will be completed by 31 December, 1992, and is expected to serve as a vital indicator of just how extensively the PETE methodology should be replicated nationally.

## B. Development of teaching materials

One of the primary problems associated with meeting PETE's objective of significantly increasing the numbers of qualified two-year Environmental-Hazardous Materials Technicians is a lack of adequate textbooks and other teaching aids. In order to address this problem, a standing Working Group has been formed by the Steering Committee to collaborate with INTELECOM-Southern California Consortium, to develop new textbooks and accompanying video sets in cooperation with national publishing houses. INTELECOM is a not-for-profit organization which has specialized for the last twenty years in the development of curricular materials for the community college level, and more recently public television programmes. The Working Group, which includes special representation from leading community colleges with hazardous materials training programmes in other parts of the US, will identify and coordinate development projects on basic teaching modules (such as an Introduction to Hazardous Materials Management and Waste Reduction) which could easily support any regional instructional programme. This is a major initiative which could amount to three-five years of effort and a cost of several million dollars. The Working Group is chartered to define the programme and develop a proposal which PETE will submit to the National Science Foundation or private foundations seeking the required funding.

## C. Standards and certification

Another key issue which PETE must consider is quality control. With multiple community college programmes in place, reasonably consistent standards and an appropriate certification process must be developed to assure employers that these technician graduates have met minimum education requirements. The PETE Steering Committee has also established a standing Working Group to address this problem. Initial thinking is focused on developing standards on a regional basis, approved by the participating states, so as to facilitate easy movement of graduates between neighboring states. The certification process might then be administered by an independent third party such as a professional society.

## D. Strategy for a national programme

The overall goal of this programme is to significantly enhance the number of graduates emerging from the education pipeline in disciplines related to environmental science and engineering, with an emphasis on technicians. The PETE methodology, as demonstrated through this regional pilot programme could be extended nationally in order to assure maximum beneficial impact. During the second year of the programme, we plan to offer advice and assistance to other DOE, EPA, DoD and NASA laboratories and facilities and community colleges to assist them in planning a similar programme in their respective regions if supported by our federal sponsors. The

PETE laboratories, community college representatives, and other partners will be available during years 3-5 to directly assist other regions in starting up their programmes, while recognizing the unique needs and resources of each region.

## E. New regional programmes

Several other regional partnerships are already starting to form. An eight state partnership entitled Project Restore has been established under the leadership of Roane State Community College (Harriman, Tennessee), the Tennessee Valley Authority and EPA. DOE at Oak Ridge, Tennessee, and their operating contractors are also participating. To date, approximately thirty regional community colleges have endorsed the programme. A third partnership is forming in eight midwestern states, led by Kirkwood and Eastern Iowa community colleges (Iowa), Delta Community College (Saganaw, Michigan) and DOEs Ames Laboratory (Ames, Iowa). Active planning is also underway in the Northwest, the Mountain Central region and Texas, and in the Northeastern states. We visualize that eventually five-six regional partnerships will offer participation to all fifty states and the US Territories.

# IV. Accomplishments and conclusion

## A. Accomplishments

Some specific accomplishments can be cited since PETE was initially funded by DOE in April 1991:

- The formation of PETE has created a regional infrastructure within which the academic community, industry, federal agencies, the states and professional societies can work together toward common goals in environmental protection, restoration and waste management education and training. The programme provides a mechanism for focused action, leveraging of resources and information sharing which is already benefiting the five participating states.
- The semi-annual Resource Instructor Conferences provide a regular forum for information exchange and mutual support among participating community colleges and the other regional partners. Two conferences have been conducted to date. The first, in San Francisco in August 1991, included representatives from sixty regional colleges and provided the Steering Committee with important input on problems and recommended priorities for PETE. The second conference was held in Las Vegas, Nevada, in February 1992. Attendance doubled from the first conference. This event focused on the issue of private sector demand for Environmental-Hazardous Materials Technicians and the pros and cons of developing national certification standards.
- During the summer of 1991, PETE assisted in the initiation of Environmental-Hazardous Materials programmes in the State of Nevada at the Community College of Southern Nevada in Las Vegas and Truckee Meadows Community College in Reno. PETE sponsored the training of the two selected instructors at the UC Davis-Extension six-week intensive programme. Eight new programme start-up grants will be made to community colleges by PETE for the summer of 1992.
- The national study of demand and skills requirements for Environmental-Hazardous Materials Technicians was initiated by The National Center for Research in Vocational Education. The final report is due on 31 December, 1992.
- PETE initiated a Summer Internship Program in May, 1992. Eight community college instructors spent six-eight weeks at the Laboratories or the Nevada Test Site working in waste operations, environmental remediation, or research and development projects.

## B. Conclusion

PETE has been established as a regional partnership approach to actively addressing the growing shortage of trained people in environmental science and technology at all levels of the US work force, particularly technicians. PETE is intended to represent a model of regional cooperation which could, and now is, being extended nationally. Leveraging resources and working together, federal and state government, the academic community, professional societies and private industry can help ensure enhanced environmental quality through the development of a better trained work force.

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